Name _____

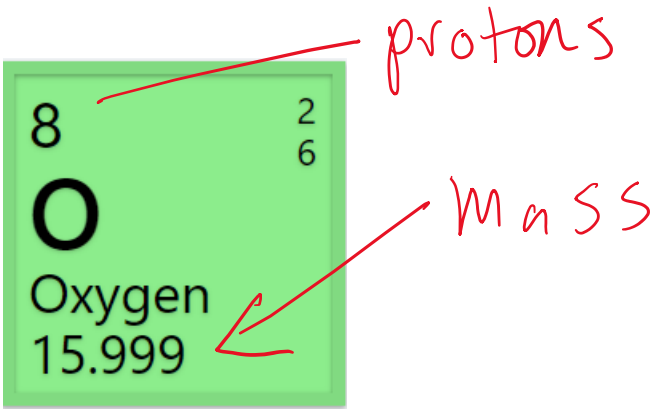
Moles mass atoms

Your Tasks (Mark these off as you go)
☐ Identify moles, mass, and atoms in a sample of an element
☐ Convert between moles and mass
☐ Convert between moles and atoms
☐ Convert between grams and atoms
☐ Receive credit for this lab

❑ Identify moles, mass, and atoms in a sample of an element

Previously we learned how to express the mass of an element in atomic mass units. The mass of any element can be identified by using the periodic table.

Below is a screenshot of oxygen from the periodic table you will be using for this lab. Notice the number on the bottom represents the mass of the element. In this lab, we will report all masses to the tenths place. So, in atomic mass units, the mass of oxygen would be written as 16.0 amu.



Atomic mass units are not a very useful measurement – we do not have an atomic mass unit balance! Grams however are. Recall that if we have an Avogadro's amount (6.022×10^{23}) of atoms, the mass of the element can be expressed in grams.

For example,

6.022×10^{23} atoms of oxygen = 16.0 g

This number is also equivalent to a mole,

1 mole = 6.022×10^{23} things

Putting this all together, we now have a relationship for moles, atoms, and mass,

1 mole = 6.022×10^{23} atom = mass of element (g)

Use the relationship below and the periodic table to complete the following.

1 mole = 6.022×10^{23} atom = mass of element (g)

No math required! Note, that 6.022×10^{23} can also be written as 6.022E23

What is the mass of 6.022×10^{23} atoms of the following?

(a) Iodine

(b) Lead

(c) Neon

How many atoms are in each of the following?

(a) 12.01 g carbon

(b) 85.47 g rubidium

(c) 118.71 g tin

What is the mass of 1 mole of the following?

(a) Tantalum

(b) Thallium

(c) Arsenic

How much in moles is each of the following?

(a) 6.94 g lithium

(b) 50.942 g vanadium

(c) 39.098 g potassium

❑ Convert between moles and mass

The relationship below can be used to calculate the mass and/or moles in a sample of atoms.

1 mole = mass of element (g)

When using this relationship, it is important to show your work. Using the units to guide you through the problem-solving process will help ensure you arrive at the correct result. Below is an example of how this can be done.

Example

Determine the number of moles in 8.0 g of oxygen.

To set up this problem we first identify the given which is 8.0 g of oxygen and the unknown which is moles.

given	conversion	asked to find (unknown)
8.0 g oxygen		**moles oxygen**

Next, we identify the conversion factor.

1 mole = mass of element (g)

On the periodic table we see that the mass of oxygen is 16.0 g,

1 mole oxygen = 16.0 g

So, we arrange the conversion factor such that what we are asked to find appears on top and what we are given appears on the bottom.

given	conversion	asked to find (unknown)
8.0 g oxygen	**1 mole oxygen**	moles oxygen
units must match	**8.0 g oxygen**	

units must match

Now that we have set up our problem, we can solve for what we are asked to find. To do this, we multiply the quantities on top, then divide by the quantities on the bottom. The result is 0.50 moles oxygen. Notice, that the grams cancel, and we end with moles as our final unit.

given	conversion	asked to find (unknown)
8.0 g oxygen ×	1 mole oxygen	**0.50 moles oxygen**
	16.0 g oxygen ÷	

g cancel

For each of the following, complete the table, then calculate the result,

How much in moles 12.0 g of helium?

given	conversion	asked to find (unknown)

How much in moles is 11.5 g of sodium

given	conversion	asked to find (unknown)

How much in moles is 1.00 g of helium?

given	conversion	asked to find (unknown)

How much in grams is 0.25 moles of argon?

given	conversion	asked to find (unknown)

How much in grams is 0.50 moles of oxygen?

given	conversion	asked to find (unknown)

How much in grams is 2.0 moles of lithium?

given	conversion	asked to find (unknown)

❑ Convert between moles and atoms

The relationship below can be used to calculate the moles and/or the number of atoms in a sample of atoms.

1 mole = 6.022×10^{23} atoms

Just as before, when using this relationship, it is important to show your work. Using the units to guide you through the problem-solving process will help ensure you arrive at the correct result. Below is an example of how this can be done.

Example

Determine the number of moles in 3.011×10^{23} atoms of oxygen.

To set up this problem we first identify the given which is 3.011×10^{23} atoms of oxygen and the unknown which is moles. Note, that 3.011×10^{23} can also be written as 3.011E23

given	conversion	asked to find (unknown)
3.011E23 atoms oxygen		**moles oxygen**

Next, we identify the conversion factor.

1 mole = 6.022×10^{23} atoms

So, we arrange the conversion factor such that what we are asked to find appears on top and what we are given appears on the bottom.

units must match

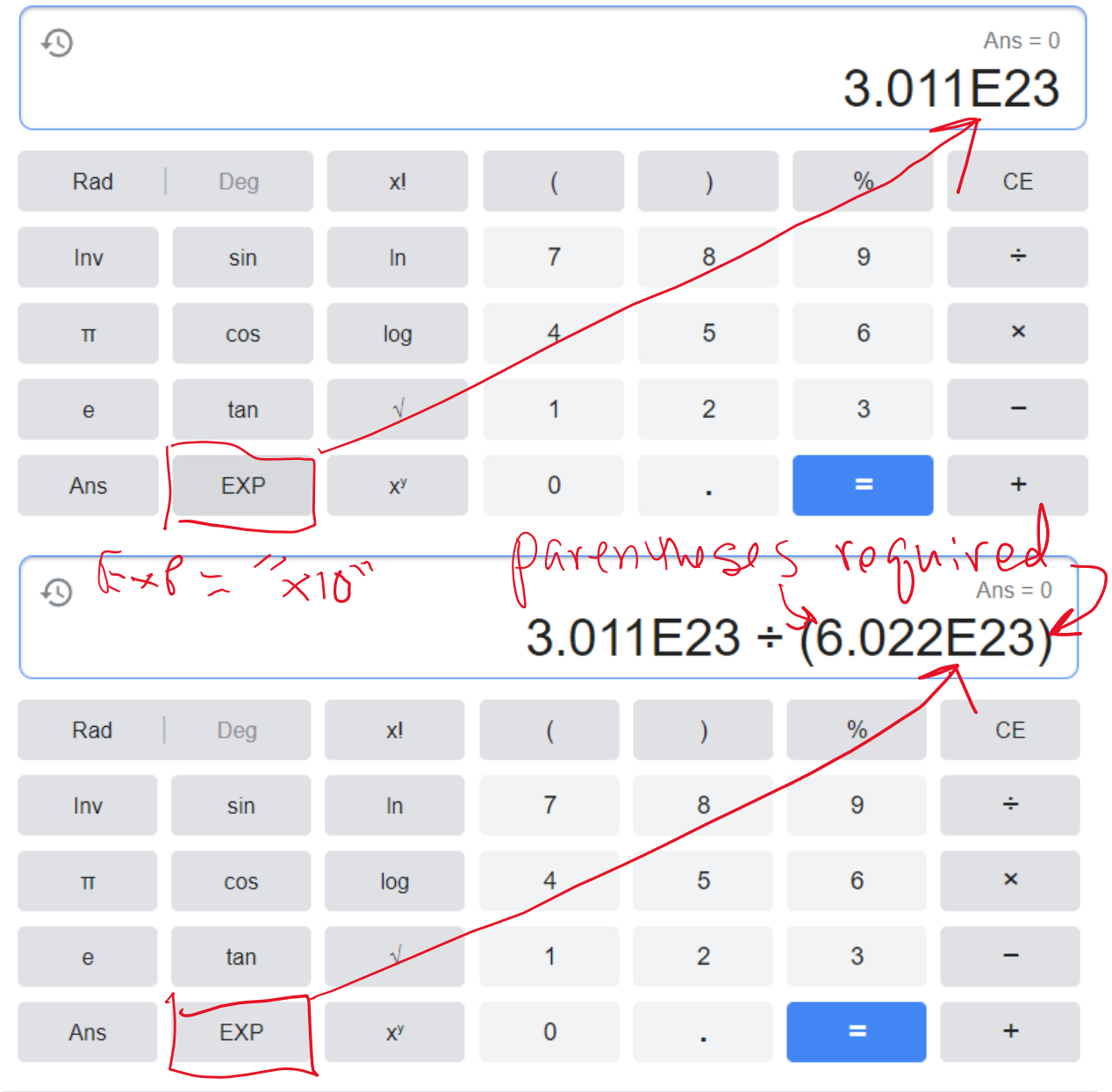
given	conversion	asked to find (unknown)
3.011E23 atoms oxygen	**1 mole oxygen**	moles oxygen
units must match	**6.022E23 atoms**	

Now that we have set up our problem, we can solve for what we are asked to find. To do this, we multiply the quantities on top, then divide by the quantities on the bottom. The result is 0.50 moles oxygen. Notice, that the grams cancel, and we end with moles as our final unit.

given	conversion	asked to find (unknown)
3.011E23 atoms oxygen	1 mole oxygen	**0.50 moles oxygen**
	6.022E23 atoms	

atoms cancel

How to type this calculation into google calculator is illustrated below,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For each of the following, complete the table, then calculate the result,

How much in moles 3.011×10^{23} atoms of helium?

given	conversion	asked to find (unknown)

How much in moles is 1.2044×10^{24} atoms of sodium?

given	conversion	asked to find (unknown)

How much in moles is 2.50×10^{23} atoms of sulfur?

given	conversion	asked to find (unknown)

How many atoms are in 0.50 moles of oxygen?

given	conversion	asked to find (unknown)

How many atoms are in 0.25 moles of lead?

given	conversion	asked to find (unknown)

How many atoms are in 2.5 moles of lithium?

given	conversion	asked to find (unknown)

❑ Convert between grams and atoms

The relationship below can be used to calculate the moles, grams and/or the number of atoms in a sample of atoms.

1 mole = 6.022 x 10^{23} atoms = mass of element (g)

Just as before, when using this relationship, it is important to show your work. Using the units to guide you through the problem-solving process will help ensure you arrive at the correct result. Below is an example of how this can be done.

Example

Determine the mass of 3.011 x 10^{23} atoms of oxygen.

To set up this problem we first identify the given which is 3.011 x 10^{23} atoms of oxygen and the unknown which is grams of oxygen. Note, that 3.011 x 10^{23} can also be written as 3.011E23

given	conversion	asked to find (unknown)
3.011E23 atoms oxygen		**g oxygen**

Next, we identify the conversion factor.

6.022 x 10^{23} atoms = mass of element (g)

On the periodic table we see that the mass of oxygen is 16.0 g,

6.022 x 10^{23} atoms = 16.0 g

So, we arrange the conversion factor such that what we are asked to find appears on top and what we are given appears on the bottom.

units must match

given	conversion	asked to find (unknown)
3.011E23 atoms oxygen	**16.0 g oxygen**	g oxygen
units must match	**6.022E23 atoms**	

Now that we have set up our problem, we can solve for what we are asked to find. To do this, we multiply the quantities on top, then divide by the quantities on the bottom. The result is 8.0 g oxygen. Notice, that the atoms cancel, and we end with grams as our final unit.

given	conversion	asked to find (unknown)
3.011E23 atoms oxygen	16.0 g oxygen	**8.0 g oxygen**
	6.022E23 atoms	

atoms cancel

For each of the following, complete the table, then calculate the result,

What is the mass in grams of 3.011×10^{23} atoms of helium?

given	conversion	asked to find (unknown)

What is the mass in grams of 1.2044×10^{24} atoms of sodium?

given	conversion	asked to find (unknown)

What is the mass in grams of 2.50×10^{23} atoms of sulfur?

given	conversion	asked to find (unknown)

How many atoms are in 8.0 g of oxygen?

given	conversion	asked to find (unknown)

How many atoms are in 20.7 g of lead?

given	conversion	asked to find (unknown)

How many atoms are in 1.75 g of lithium?

given	conversion	asked to find (unknown)

❑ Receive Credit for this lab

Each group member must complete and submit their own lab to receive credit